ON THE ROAD: FROM INDUSTRY 4.0 TO SOCIETY 4.0

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Abstract: The contribution builds on the desk research approach based mainly on studies performed by leading world´s consultancies and agencies as the World Economic Forum, the World Bank and others, academic research performed e.g. at MIT and Harvard Business School, and other resources, and follows the one presented at the 2016 IMECS conference (Vacek, 2016). It focuses on the deep impact of Industry 4.0 on socio-economic issues resulting in what can be called Society 4.0. The contribution tries to highlight the challenges presented to society, economics and management by technology advancements and draw attention to building of necessary synergies between technology and socio-economic systems. The prevailing emphasize is today devoted to technology issues. According to author´s opinion the rapidly advancing technology, if not accompanied by profound changes in socio-economic systems, can result in weakened social cohesion. Instead of pure technology transfer we should today discuss much broader category of knowledge transfer. Ample attention should be paid to intellectual capital, its protection, assessment, and reporting.
This contribution does not pretend to present results of the primary field research. The opinions and conclusion expressed here are intended to open the discussion in the field the importance of which is until now overshadowed by that given to purely technological aspects.

Keywords: Industry 4.0, Society 4.0, socio-economic issues, skills and competencies, intellectual capital

JEL Classification: M10, O33, E24

"Nothing behind me, everything ahead of me, as is ever so on the road."

Jack Kerouac, On the Road

INTRODUCTION

Industry 4.0 knocks on the door. Its most visible representatives – robots, introduced to the literature by Karel Čapek and popularized by sci-fi writers – in fact entered the doors of factories already in the second half of the last century, mainly in the automotive sector, where they replaced human workers in most unpleasant and dangerous jobs in welding and painting shops. Later on, they became space explorers, assisted people in mitigation of consequences of disasters as Chernobyl and in other jobs dangerous to humans. Today they enter new areas of applications not only in industry, but also in services, including social and health care. They proved their usefulness, however since their appearance in literature the authors discussed also their potential threats. Similar dichotomies can be followed in other components of the 4th industrial revolution from computers to artificial intelligence.

The current prevailing focus of Industry 4.0 is technology. However, such a look is rather narrow. The in-depth dichotomy between the Industry 4.0 technologies and their socio-economic consequences have analogous reason as disruptive innovations introduced by Christensen in (Christensen, 2000): the technology progress is faster than the absorption capacity of the society. What Christensen suggests as innovator´s solution can be as well applicable to Industry 4.0: society should not wait to be disrupted – it is never too early to prepare for the future. This implies necessity of deep socio-economic innovations and measures employing potential opportunities and preventing potential threats. It means to step on the higher level than Industry 4.0 to what can be called Society 4.0. By the way, Japan already launched the initiative Society 5.0. In the 5th

Science and Technology Basic Plan (Japan's 5th Science and Technology Basic Plan (2016-2020)), a super smart society is defined as "a society where the various needs of society are finely differentiated and met by providing the necessary products and services in the required amounts to the people who need them when they need them, and in which all the people can receive high-quality services and live a comfortable, vigorous life that makes allowances for their various differences such as age, sex, region, or language."

The term "4th industrial revolution" implies that it is not a brand new phenomenon in the history of mankind and this revolution shares many aspects with its predecessors. Technology advances always raised worries about job losses and the history showed they had not materialized. What distinguishes the 4th industrial revolution from its predecessors is the speed of technology changes: the trend is no more linear, but exponential and therefore the society may not have enough time to adapt. Furthermore, the absorption capacity of the society is hindered by its much higher complexity; legislation and bureaucracy often create barriers to changes, socio-economic systems are very inertial. In the EU, we see increasing risk aversion and lack of the entrepreneurial spirit. As a result, we do not have so much time (and often the courage) available for adoption of rapidly advancing technologies as in previous waves of industrial revolutions.

The following sections of the contribution will focus on employment and jobs, benefits and threats of new technologies (section 1), and role of socio-economic research, education and training for development of required competencies (section 2). The contribution builds on the desk research approach based mainly on studies performed by leading world´s consultancies (Mc Kinsey, Accenture, Deloitte, PwC) and agencies as the World Economic Forum, the World Bank and others, academic research performed e.g. at MIT, Harvard Business School and Oxford Martin´s School, and other resources. Here we can refer to only little of them, e.g. (Acemoglu & Restrepo), (Chui, Manyika, & Miremadi, 2016), (WEF, 2016). Number of publications concerned with Industry 4.0 socio-economic aspects are not published in scientific journals listed in WoS and Scopus, highly valued by academic community, but in research reports of consultancies (mostly available on the web). World Economic Forum publishes weekly survey of articles, many of them dealing with the area of interest of this contribution. Currently there appear monographs and books as (Brynjolfsson & McAfee, 2014), (Ford, 2016), (Schwalb, 2017), (Ross, 2017) that became bestsellers. They cover not only technological views on the 4th Industrial revolution, but deal with broad range of its socio-economic aspects. Brynjolfsson & McAfee give an extensive review of opportunities and threats, Ford deals extensively with the changes in employment induced by robots, artificial intelligence and other technologies, Schwalb discusses the major impacts on society and in the appendix provides a list of ideas for what can be done for better future of us all. And Ross, former senior advisor of Hillary Clinton for innovation (does any of us know a similar position in our contry?) uses his experience to give vivid perspective how global trends are affecting the ways we live and will live in the future. Generally, the outlook to the future with time gets more positive, especially among social scientists. Quite interesting is pessimism of highly respected people like Bill Gates, Elon Musk, Martin Rees, Stephen Hawking. Slight concern can arise if we compare the reliability of economic and technological predictions.

This contribution does not pretend to present surprising results of the primary field research. The opinions and conclusion expressed here are intended to open the discussion on the importance of issues until now overshadowed by that given to purely technological aspects.

1. EMPLOYMENT AND JOBS. BENEFITS AND THREATS OF NEW TECHNOLOGIES

Most discussions about influence of the 4th industrial revolution on the society focus on employment and jobs. In the widely cited paper of Oxford Martin School's researches (Frey & Osborne, 2013) the authors developed methodology based on the Routine Task Intensity (RTI) to estimate the probability

of computerization for 702 detailed occupations and concluded, that about 47 % of total US employment is at risk. Principles of this approach were adapted to the situation in Czech Republic in (Chmelař & kol., 2015).

In July, 2016, Mc Kinsey partners used another approach (Chui, Manyika, & Miremadi, 2016). The authors say that in fact very few occupations will be eliminated entirely, however automation will affect portions of almost all jobs. They conclude that "currently demonstrated technologies could automate 45% of the activities people are paid to perform and that about 60% off all occupations could see 30% or more of their constituent activities automated". The conclusion of their research is that while technical feasibility is a necessary condition for automation, it is not sufficient. It is necessary to take into account the following factors:

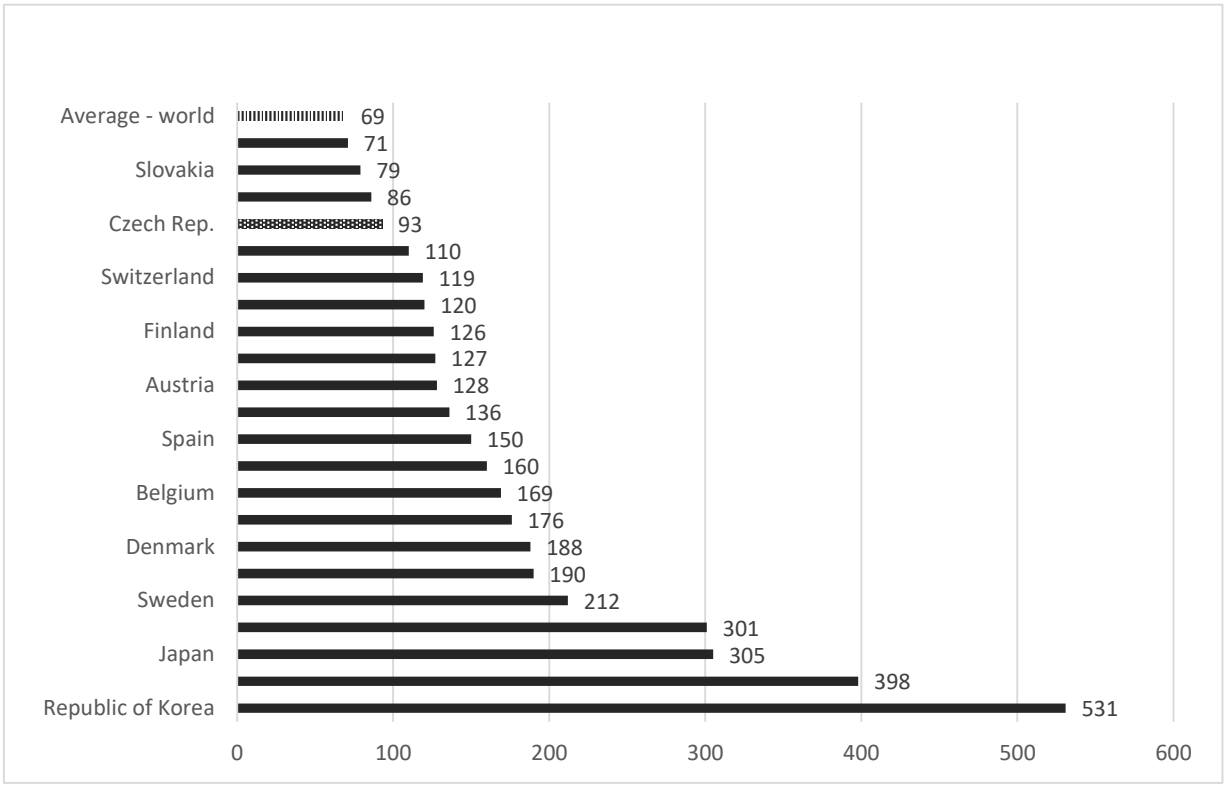
- related costs (technology needs to become more affordable when compared to the cost of labour),
- the availability, skills and cost of workers who might do the activity,
- benefits of automation (reliability, precision, performing tasks in dangerous environment, etc.),
- regulatory considerations and social acceptance.

The extensive McKinsey report (Manyika & al., 2017) concludes, that "today's automation fears essentially rest on two assumptions. First, the speed of advances in digital software and hardware is faster than in previous waves of technological change. And second, clever software and machines are increasingly able to automate cognitive tasks, not just physical ones. Artificial intelligence, it seems, poses a new kind of threat to jobs — not so much replacing muscle but brains."

Analyses of McKinsey's and other authors warn that automation could cause labour displacement, income inequality, and depressed wages, because the owners of the machines (i.e. owners of capital) benefit most from increased productivity. This results in the opening of scissors between the small minority of very rich and the rest of the society, what can result in the destruction of the social peace; middle class that was in the past motivated by the possibility to raise to higher level of the society is today mostly afraid of losing their position and sink among the poorer. And it is the middle class that is important for liberal democracy.

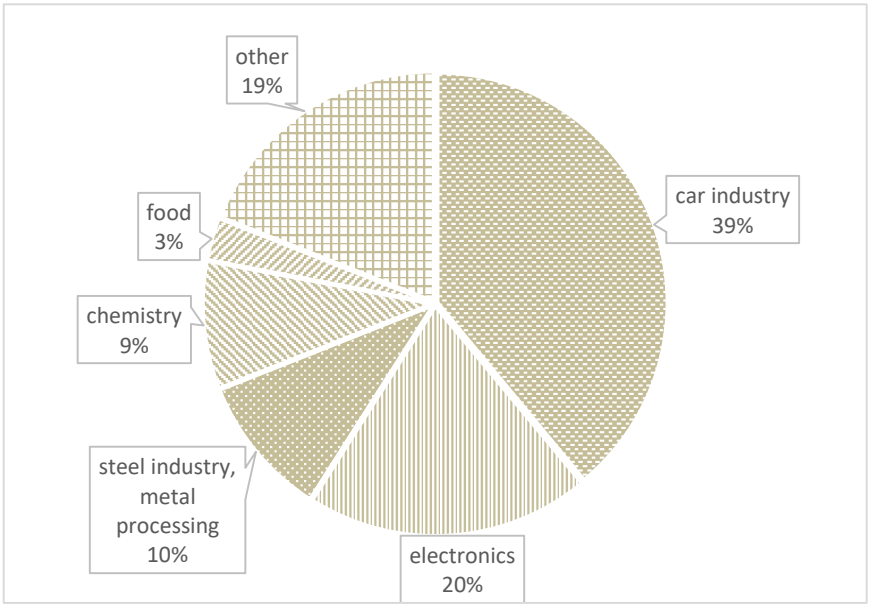
Probably the most advanced and implemented technology is robotics. International Federation of Robotics (IFR) survey shows the number of robots per 10 000 employees (see Fig. 1). We can see that most robots work in highly industrialized countries, often with unfavourable age structure of the population, where robots replace the missing human workforce. The distribution of robots in different industries can be illustrated on data for the Czech Republic presented in Fig. 2. More than a half of robots work in car and electronic industries, mostly replacing people in routine manual jobs. However, as the IFR analysis shows, there is a growing segment of robots working in services, especially in social services, where they can assist the older generation an sick people. It can be expected that the number of openings for jobs in social services both for robots and people will be increasing, the problem is how to cover the related expenses.

Figure 1 Number of robots per 10 000 employees



Source: Processed from World Robotics Report 2016, (International Federation of Robotics (IFR), 2016)

Figure 2 Robotization in Industries – Czech Republic



Source: Adapted from (Vyhnanovský, 2017)

2. ROLE OF SOCIO-ECONOMIC RESEARCH, EDUCATION AND TRAINING FOR DEVELOPMENT OF REQUIRED COMPETENCIES

The optimistic look says that if history does repeat itself, new tasks and new jobs will be created with advances in technology, even as other tasks and professions become automated. However, today we can hardly say which new jobs will emerge.

Productivity estimates of (Manyika & al., 2017) assume that people displaced by automation will find other employment. Many workers will have to adapt to new requirements, and business processes will be transformed. Humans will still be needed in the workforce: the greatest total productivity gains will result if people and machines collaborate. That in turn will fundamentally alter the workplace, requiring a new degree of cooperation between workers and technology.

Nobody denies importance of socio-economic research, however this research cannot rely on resources provided by businesses: they are prepared (and already many of them) support technological developments. Support of socio-economic research will have to be provided by public sector. Until now the situation in the Czech Republic in this respect is not clear – the most expected program with this purpose TAČR ETA published the first calls for proposals by the end of May. The amount of money allocated to this program is hardly comparable will a variety of programs focused on technological development. Moreover, many of the technologies already in some form exist and the barrier e.g. for the broader use of robots is often not technological, but their higher price in comparison with cheap human labour. It can be expected that the price of robots will be decreasing, while price of human labour will be increasing – and at a break-even point the manufacturing companies will not hesitate to replace humans by robots that will be not only cheaper, but more reliable, will not get tired or angry with their colleagues.

It is generally agreed that a fundamental step is educational reform. The students should become familiar not only with new technologies, but also with social, economic and ethical issues connected with their implementation. The concept of the mainstream Industry 4.0 seems to be too narrow – what we need is the convergence of technologies with humans.

The cooperation of schools with practitioners from different areas should become more broad – the people with practical experience should participate more in educational activities. Unfortunately, the academia often builds artificial barriers preventing the full use of their capacities: their names usually are not surrounded by respected academic degrees, they do not have publications in impacted journals and therefore do not satisfy academic standards required for their full inclusion to academic life.

The WEF report (WEF, 2016) forecasts what competencies are expected from young people who just started their secondary and tertiary studies and are supposed to complete them around 2020. Share of jobs requiring specific skills as part of their core skill set is summarized in Table 1 below.

Table 1 Share of jobs requiring specific skills as part of the company core skill set

Category of skills	**Share (%)**
Complex Problem Solving Skills	36
Social Skills	19
Process Skills	18
Systems Skills	17
Resource Management Skills	13
Technical Skills	12
Cognitive Abilities	15
Content Skills	10
Physical Abilities	4

Source: processed from data (WEF, 2016, str. 22)

Overall, social skills—such as persuasion, emotional intelligence and teaching others—will be in higher demand across industries than narrow technical skills, such as programming or equipment operation and control. Content skills (which include ICT literacy and active learning), cognitive abilities (such as creativity and reasoning) and process skills (such as active listening and critical thinking) will be a growing part of the core skills requirements for many industries. If skills demand is evolving rapidly at an aggregate industry level, the degree of changing skills requirements within individual job families and occupations will be even more pronounced.

And compare this demand prediction with our current study programs. I would say the demanded skills are not properly covered. The schools should resist the short-sighted demand of industrial lobbies to prepare young generation for the needs of today´s labour market. Companies should not rely on the government that the schools will supply the demanded work force for their current needs. They should take more substantial deal of responsibility and – moreover – on the lifelong education of their employees that will be necessary for rapidly changing job market.

The educational system is one of the most conservative and inertial systems in the society, so that it should focus on long-term perspective: what competencies and skills should have those entering secondary schools and universities today need after they graduate. That is the responsibility of many of us among the educators.

CONCLUSION

The prevailing opinion of authors of relevant publications is that the history will not repeat itself in every detail. We can expect the stormy transitions period in which many human activities will be automated, however the optimistic view says that people will learn not to take machines as competitors but as partners. As any dynamic system with delayed feedback, the techno-socio-economic system will exert oscillations and we can hope they will lead to a new equilibrium.

The extremely important role will have the education for future. Instead of pure technology transfer we should discuss much broader category of knowledge transfer. Ample attention should be paid to intellectual capital, its protection, assessment, and reporting. We need enthusiastic, courageous, ambitious and forward-looking decision makers thinking in the horizon longer than the election period.

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